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Transfer of Ecological Technologies to Ukraine

Responding on the challenges of a global climate change, the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UN FCCC) has set limits for the Annex I countries that carbon emissions have to be reduced to the 1990 level, or to 5-10% below 1990 level during 2008-2012. Emissions limits for some countries listed in Annex I are presented in Table 1.

Table 1. Emissions limits for some Annex I countries (% relative to 1990 base year)

Annex I Country	**Limits, %**		**Annex I Country**	**Limits, %**
Australia	108		Russia	100
Iceland	110		USA	93
Canada	94		Hungary	94
New Zealand	100		**Ukraine**	**100**
Norway	101		Japan	94
Poland	94		European Union	92

Source: Annex B to the Kyoto Protocol

It is seen from Table 1 that Australia, for example, may increase its emissions of greenhouse gases (GHG)[1] by 8% in comparison with 1990 – a base year used for the Kyoto Protocol. From another side, the European Union has to cut its emissions of GHG by 8% during 2008-2012 in order to implement its obligations. A complete list of countries and their obligations are presented in Annex B to the Kyoto Protocol.

To enter into law, and therefore to become binding on the countries that are parties to it (but not other countries), the Protocol must be ratified by at least 55 countries, responsible for at least 55% of the total carbon-dioxide emissions of the Annex I countries listed in Annex I to the FCCC in 1990. Most countries signed the Protocol, but putting a signature on a treaty does not obligate a country to ratify it.

Nowadays there is a doubt that the USA will not ratify the agreement. The US Senate in July 1997 adopted the Byrd-Hagel Resolution, which stipulates that the USA should not accept the commitments to limit or reduce GHG until developing countries have also specific scheduled commitments to limit their GHG within the same period of time. Even if the USA does not ratify the treaty, it is possible that the agreement will still come into force. The USA accounts (only) for 36% of Annex I 1990 emissions, and if all other Annex I countries will ratify it, the Protocol will be affective.

However, if the USA does not ratify the agreement, other Annex I countries will benefit less from participating. These countries will have to undertake the emission reductions set by the agreement without the benefit of substantial US abatement. Therefore, it seems that many Annex I countries will await US ratification before serving the Kyoto Protocol up to own parliaments. It is also possible, that if the USA does not ratify the agreement, then it may not enter into force at all.

[1] GHG include carbon dioxide, methane, nitrous oxide, fluorocarbons, tropospheric ozone, and sulphur hexafluoride. For measurement conveniences, they are presented in terms of carbon (C) or carbon dioxide (CO_2) in an aggregate measure with the weights attached to individual gases.

Of course, predicting whether Kyoto will be implemented, or whether it will achieve positive results if implemented, depends on many details. According to Barrett's analysis (Scott Barrett, 1998), it depends on assumptions about how the important concepts in the agreement will be interpreted, about the institutions that will be developed to support it, about the costs of taking actions, and about the future evolution of the treaty. All these details are uncertain.

The Kyoto Protocol provides some flexible mechanisms in order to support a cost-effective allocation of climate-change mitigation. They include emissions trading, joint implementation, and clean development mechanism. These mechanisms were introduced to the Protocol with a purpose to reduce mitigation costs as a whole.

Suppose that the limits negotiated in the Kyoto were met exactly in each Annex I country. Lets say that the EU reduced emissions to 92% of its 1990 emissions, the USA to 93%, etc. As was presented in the Table 1, Ukraine was committed to keep its emissions within 1990 level, and other developing countries, not Annex I members, were entirely unconstrained by the agreement. The marginal costs of climate-change mitigation would be different for all countries. According to some analysis, marginal costs will be between 125$ (Nordhaus and Boyer, 1998) and 240$ (Manne and Richels, 1998) per ton of carbon in 2010 for Europe and the USA. These reflect modeling estimates of meeting the commitments without international flexibility. Marginal costs for Ukraine and other developing countries, including other former USSR countries, for compliance of the Protocol are equal to zero. Such a big difference in the marginal costs for developing and industrialized countries implies a huge costs for mitigating emissions. With this reason flexible mechanisms were incorporated to the treaty, and therefore, shifting one ton of abatement from the industrialized (OECD) country to developing countries would save the world from 125$ to 240$. The biggest national (for the USA) economic study of the cost of the Kyoto commitments, by the US administration, assumed full flexibility and estimated that the actual marginal costs to the US would lie in the range 14$/tC to 23$/tC (Yellen, 1998). The study estimated that this was about a quarter of the costs in the absence of international flexibility.

Perhaps the most important flexible mechanism in the Kyoto Protocol is the provision for trading among Annex I countries. According to the Clinton Administration's analysis, this provision could lower the marginal cost of implementing Kyoto by 72%, and lower the total cost of implementation by 57%, compared with the scenario of meeting the national targets without international cooperation.

The idea for emissions trading based on the difference in the marginal costs is the following. If the marginal costs associated with the reduction of emissions are different across regions, the aggregate cost of meeting the commitments will be less to the extent that a region with higher marginal costs can induce a region with lower marginal costs to abate more on its behalf. Figure 1 illustrates the gains from trading for two regions, R_1 and R_2, subject to the constraints: CO_2 abated = q_1 for R_1 and q_2 for R_2.

By abating more, the lower cost region produces rights to emit (or emission permits), which it can sell to the higher cost region, which would thereby avoid the same amount of higher cost domestic abatement. Thus, the difference in the marginal costs associated with each region's commitment in the absence of trade creates a potential gain to be shared in some matter between them. The aggregate emission reduction will be achieved at least cost when the two regions trade until their marginal abatement costs are equal at what will then be the market-clearing price for the right to emit carbon.
Figure 1. Marginal Abatement Curves (MACs) Used for Trade Studies.

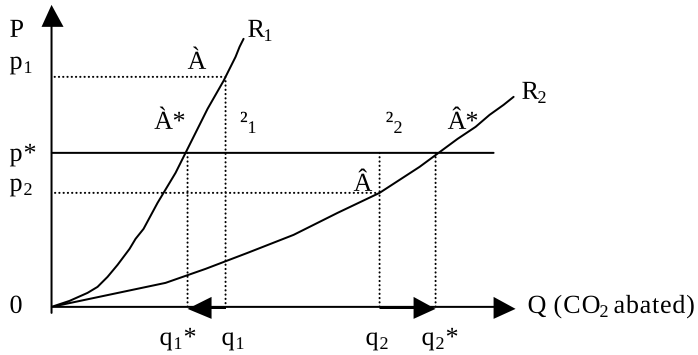

Table 2 displays the cost calculations in the no trading and trading cases. These cost calculations can easily be generalized to n regions, and they constitute the basis for emissions trading studies using MACs.

Table 2. Basics for Trade Studies

	No Trade	**Trade between R_1 and R_2**
Constraints	R_1: q_1 abated R_2: q_2 abated	R_1 and R_2: $q_1 + q_2$ abated
Marginal Cost / Market Price	R_1: p_1 R_2: p_2	R_1 and R_2: p^* such that $p^*(q_1^*) = p^*(q_2^*) = p^*$ and $q_1^* + q_2^* = q_1 + q_2$
Abatement Cost	R_1: area $A0q_1$ R_2: area $B0q_2$	R_1: area $(A^*0q_1^*)$ R_2: area $(B^*0q_2^*)$
Emission Permits Trading	NA	R_1: buys right to emit $q_1 - q_1^*$ R_2: sells right to emit $q_2^* - q_2 = q_1 - q_1^*$
Imports (+) / Exports (-) Flows	NA	R_1: pays $p^* x(q_1 - q_1^*)$ = area $(A^*I_1q_1q_1^*)$ to R_2 R_2: gets $p^* x(q_2^* - q_2)$ = area $(B^*I_2q_2q_2^*)$ from R_1
Total Cost	R_1: area $A0q_1$ R_2: area $B0q_2$	R_1: area $(A^*0q_1^*)$ + area $(A^* I_1q_1q_1^*)$ < area $(A0q_1)$ R_2: area $(B^*0q_2^*)$ - area $(B^*I_2q_2q_2^*)$ < area $(B0q_2)$
Savings from Trading	NA	R_1: area (AI_1A^*) R_2: area (BI_2B^*)

MACs in the economies in transition will be zero without Annex I trading. Trading, however, will lower costs for all Annex I countries by redistributing abatement within Annex I group of countries, such that marginal costs are everywhere equal.

The Kyoto Protocol also allows joint implementation trades among Annex I countries. These are bilateral project-based, rather than market-based, trades, in which one country receives emissions reduction units for undertaking projects in another country that reduce net emissions.

Joint implementation will be beneficial for both as for developing such as for developed countries, and will help to stabilize emissions in the world. Mitigation measures require investments and technical experience. Developing countries and countries with transition economies are lack of financial resources because of economic instability and limited access to the international financial markets. At the same time developed countries look for cheap possibilities to reduce emissions. Joint implementation mechanism provides these countries with a possibility to achieve lower level of emissions in more efficient way.
Moreover, developing countries and countries in transition may obtain benefits from international cooperation in terms of new technologies and know-how. Joint implementation positively affects on the development of the international technology market.
The third Kyoto flexible mechanism is the clean development mechanism (CDM) - the joint implementation extended to include non Annex I countries. This allows Annex I countries to meet their emissions obligations by undertaking projects in developing countries that provide additional emission reductions. It may shift abatement possibilities toward the non-Annex I countries. Some developing countries, like India and China, may also provide a potential market for emissions reduction. Participation of non-Annex I countries in the international market will reduce the total emission costs, but the CDM has a number of problems

concerning certification of such emission reductions and another that one of the CDM party will not have its emissions capped.

The GHG emissions in developed countries have grown up in comparison with developing countries since 1990. It may be explained by faster rate of economic growth. A more stringent level of mitigation that may be reached, combined with a time the emissions controls are implemented, implies that annual reductions requirements are more rigid for developed countries rather than for counties like Ukraine, where has been a huge reduction of industrial and agricultural activities after 1990 and respective reduction of GHG emissions.

Ukraine signed the UN FCCC in 1992. The Verkhovna Rada (Parliament) of Ukraine ratified the Convention on October 29, 1996 and Ukraine became a Party to the UN FCCC on August 11, 1997. Ukraine is a member of Annex I of the Convention, which includes developed countries and countries with economies in transition. On March 15, 1999 Ukraine signed the Kyoto Protocol to the UN FCCC. The Protocol is not a part of acting legislation of Ukraine, as it still has not been ratified by the Parliament of Ukraine.

Since getting independence in 1991 Ukraine experienced an economic recession, followed by decline in GDP, high level of inflation, etc. The industrial output had a negative trend either. Only in 2000 the government of Ukraine has stabilized macroeconomic situation in the country and nowadays trying to recover the economy. Accordingly, there was a decline in the GHG emissions; the GHG emissions declined more than 50% in comparative with 1990 level. According to the First National Communication on Climate Change to the FCCC prepared by the government of Ukraine (the Ministry of Ecology and Natural Resources of Ukraine) in response to the FCCC regulations, there was submitted the Greenhouse Gas Inventory Report. In accordance to that report, the GHG emissions in 1998 declined almost by 65% comparatively with a base 1990 year. The dynamics of the GHG emissions are presented in Table 3 and on Figure 2.

Table 3. The GHG emissions, CO_2-equivalent, Gg

Gas	**1990**	**1995**	**1998**
Carbon dioxide	652 734,4	289 522,2	194 114,5
Methane	199 201,7	129 829,7	110 992,4
Nitrous oxide	28 531,6	13 062,9	10 789,5
Total	879 825,3	432 414,8	315 896,4

From the data presented in Table 3 it is seen that Ukraine has no problems with its obligations set in the Kyoto Protocol (Ukraine is obliged to limit its emissions to the 1990 level). Moreover, Ukraine has a potential in an amount of 563 930 Gg CO_2-equivalent for participation in the flexible mechanisms described above, namely emissions trading and joint implementation. It is worth to mention that the compliance period is 2008-2012, and to be sure that Ukraine has potential possibilities to participate in the flexible mechanisms, it is necessary to have projected data for that period.

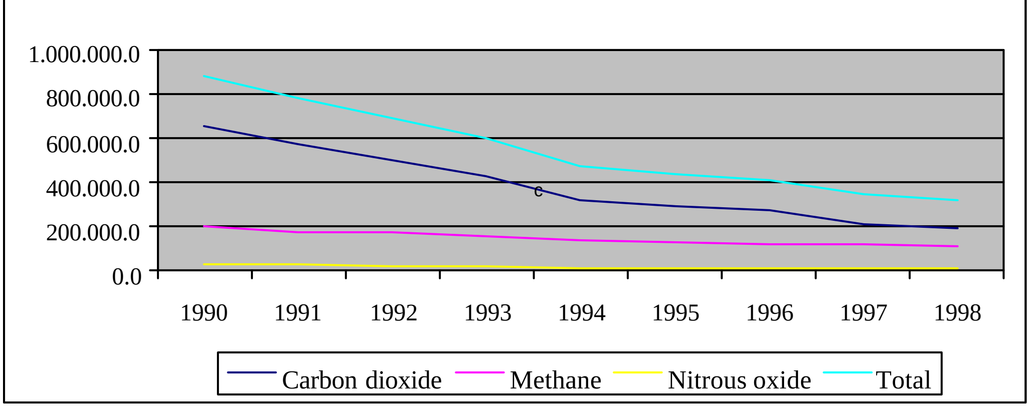

Figure 2. The GHG Emissions, Gg ÑÎ 2

There were produced many papers regarding projections of the GHG and mostly they concern the status of the USA and the EU. Of course they take into account emissions in developing countries, but usually they report emissions for the former USSR (base year 1990) or for Russia. Limited number of papers report projected GHG emissions for Ukraine. Brunello and Kostyukosvky made analysis on the potential benefits for Ukraine in the emissions trading on the international market, where they also analyzed the GHG emissions in 2010 for Ukraine. They incorporated international and local analyses, and according to them the projected GHG emissions for Ukraine in 2010 will vary from 105 mln.t C to 203 mln.t C. Differences in the projections may be explained by different assumptions in the models regarding economic and technological development, as well as by the structure of the models. It is necessary to mention that Ukrainian projections (105-157 mln.t C) are more accurate because they better characterize the current situation in the economy of Ukraine and their assumptions regarding technological developments are more realistic. Taking into account that in their report emissions in 1990 were on the level of 240 mln.t C, Ukraine will have a potential to propose to the international market from 37 to 135 mln.t C.

There are another projections made by Ukrainian experts (Shevchuk V., Trofimova I, and other) that emissions in 2010 will vary from 535 mln.t CO_2 to 619 mln.t CO_2. Based on their analysis the potential for participating in the emissions trading market will be estimated on the level of 179-300 mln.t CO_2.

In the IIASA research (Victor et all, 1998), there was estimated the resources that may be traded using several prices for emission rights. The lowest possible price they used was 20$/tC, which is within the range 14-23$/tC, but this price assumption was criticized by analysts as there is no sure about widespread availability of low-carbon abatement options and extensive markets in emissions trading. Authors used more realistic assumptions 50$/tC and 150$/tC, the range of permit prices remains wide because there is no exact abatement costs and there is no agreements on forms of emissions trading. Using different scenarios of development (economic growth and carbon-intensive technologies) they estimated the proposed amount of emissions rights from Ukraine – around 200 mln.t C.
In my opinion the international price on emission rights will be lower and will be in range from 5$/tC to 20$/tC. Playing with data analyzed above one may come out with a figure that estimates possible benefits for Ukraine from participation in the international emissions trading market. These figures also vary and demonstrative calculations are presented in Table 4.

Table 4. Possible benefits for Ukraine from Emissions trading

Quantity, mln.t C	Price, $/tC	Benefit, mln.$
37	5 20	185 740
135	5 20	675 2 700
200	5 20	1 000 4 000

Based on the projections described above it is clear that the GHG emissions in Ukraine in 2010 will be lower than in 1990. It is not known so far how much exactly Ukraine may sell to the market but it is clear that Ukraine will gain from participation in the flexible mechanisms of the Kyoto Protocol. However, it is not clear so far what will happen with the GHG emissions in Ukraine in 2020.

Another potential mechanism for Ukraine is the joint implementation. As the economic situation in Ukraine is tough, an improvement in the economy may be achieved by increasing production of goods and services using existing technologies, and to some extent, new technologies. Nowadays, equipments and technologies in Ukrainian energy sector are depreciated by more than 50%, and they require technical reconstruction and improvement. The situation will be more complicated in 2008-2012 without investments in the sector.

Potential benefits for the country-beneficiary depends upon difference between local mitigation costs and the investor's mitigation costs. Mitigation costs are much lower in

Ukraine as in Ukraine prevails old and non-efficient technologies. Moreover, Ukraine is highly needed foreign investments for installation of new technologies. Therefore, the joint implementation mechanism creates unique possibilities to attract foreign investments to Ukraine and makes Ukraine more attractive for potential investors. Market for joint implementation projects will be very competitive in the future because a lot of developing countries want to receive foreign investments. From another side, country-investors are limited in a share of emissions to be cut abroad, because main part of the emission reduction must be met domestically.

Therefore, Ukraine has to create attractive conditions for industrialized countries-investors to choose Ukraine as a partner for the joint implementation projects. Such attractive conditions should include clear legislation, simple and clear procedure of development and verification of the projects, creation of the legal body (institution) which will be responsible for coordination of the projects, i.e. valuation, approval, registration, monitoring, certification, verification, etc. It is clear that development of such projects requires a lot of efforts and time. And it is unknown so far how these projects will be financed on the early stages of their development. So, in order to avoid risks concerning development of the projects it is recommended that the institution, that will be created, should be regulated and financed by the government of Ukraine. It is sure that creation of the governmental institution does not avoid all risks concerning implementation of the joint implementation mechanisms, as there are some other risks connected with the flexible mechanisms and the Kyoto Protocol in a whole.

Joint implementation mechanisms in different countries are on different stages of development. Some industrialized countries have developed pilot projects that assisted them to verify approaches to project certification. In Ukraine such experience is limited because no one joint implementation project has been registered so far. One of the main problems for that is absence of the institutional development in this direction.

Therefore, taking into account ideas mentioned above, Ukraine has an opportunity to get a benefit from the participation in the flexible mechanisms of the Kyoto Protocol. It is difficult to estimate the potential in terms of money flow from the emissions trading or flow of technologies from the joint implementation mechanisms, but it is clear that without active development of the institutional conditions now, Ukraine will fail in the competition on the international market. From another side, using the Kyoto mechanisms, Ukraine may get modern cost-effective technologies and will improve the situation in the energy sector and in the national economy in a whole.

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